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Processing Multi-Image Scenes on the Precision Targeting Workstation (PTW)

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Overview

- Multi-Image Scenes
  - Collection Types
  - Chipping in Multi-Image Scenes
- PTW Processing of Multi-Image Scenes
  - Operational Capabilities
  - Multi-Image Processing Approach
- Characteristics of the Multi-Image Scene Solution

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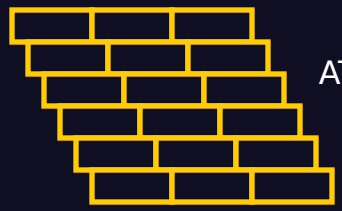
Multi-Image Scene Collection Types

ASARS-2
ASARS-2A
ATARS SAR
Global Hawk SAR

Scanning SAR

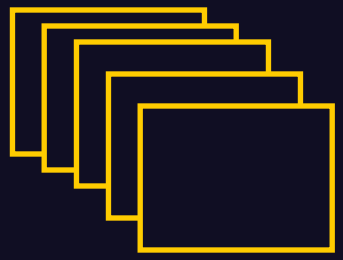


ATARS
IRLS

Optical Whiskbroom

ATARS LAEO
ATARS MAEO
SYERS
SYERS-2

Optical Pushbroom

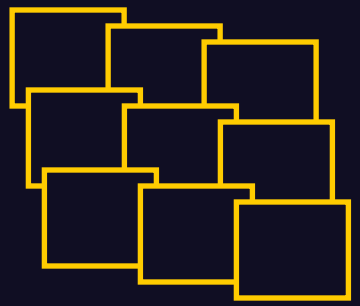


Predator EO/IR

Optical Video

Sometimes the pixels collected at one time are combined with pixels collected at a slightly different time

Sometimes images are segmented (e.g. chipped for processing, storage, or transmission)



Global Hawk EO/IR
SHARP EO/IR
TARPS CD

Optical Step Framer

Time is important in defining the type of multi-image scene

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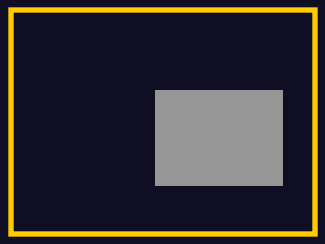
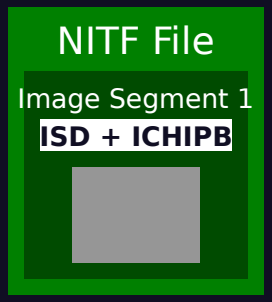
Chipping from Multi-Image Scenes





Chipping From a Single Image

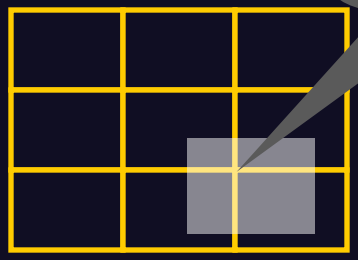
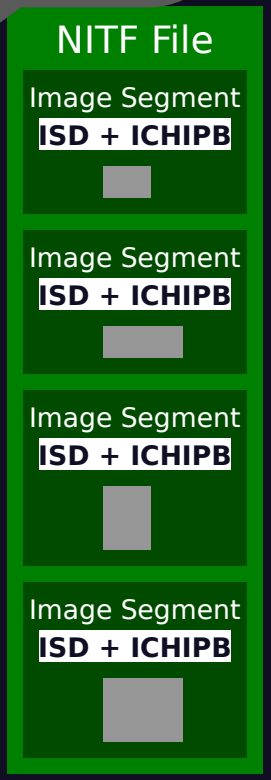
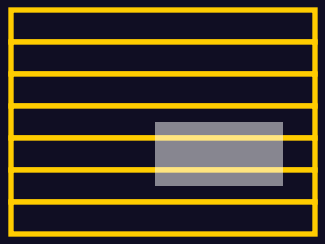


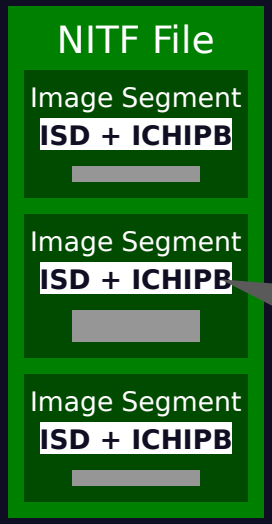
Image segments may overlap



Chipping From Images Segmented in Two Directions



Chipping From Images Segmented in Strips



All of the original image support data is retained with the imagery from the original image segment

Multi-image chips are produced according to the corresponding screener display

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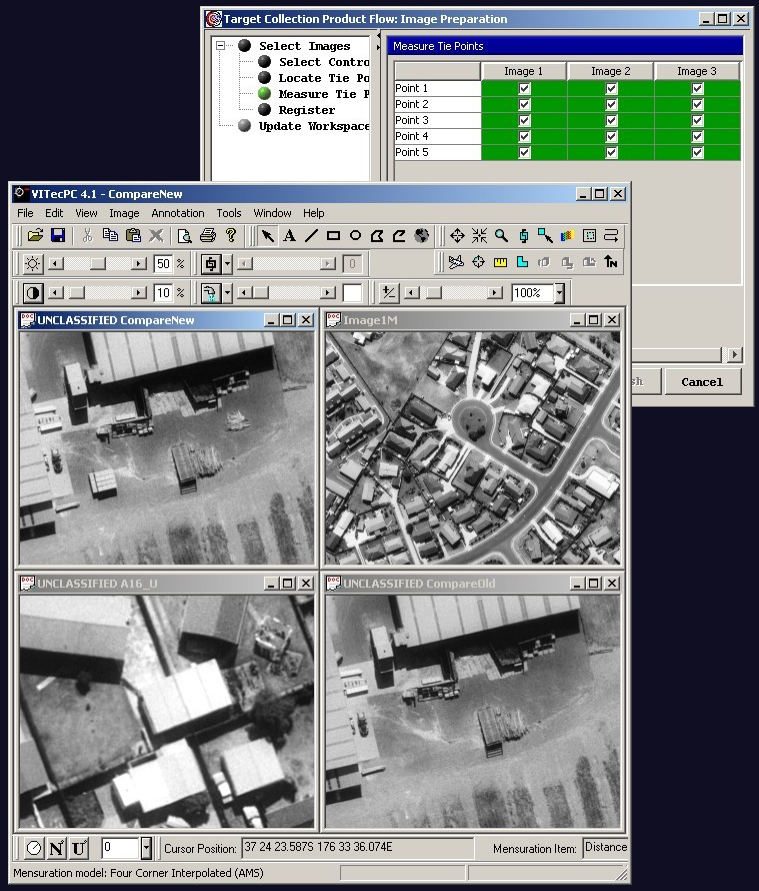
PTW Geopositioning

- Imagery is selected according to targeting requirements
  - target area
  - timeliness of image collection
  - desired accuracy
  - preferences for image type
- Images are optionally registered using a small number tie points; DPPDB is employed as a high accuracy source when necessary
- Target points are collected
  - using a single image together with an elevation model (e.g. DTED)
  - using multiple images
- Statistically estimated target position uncertainties are provided



Geometric sensor models are key to image registration and targeting

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Processing Multi-Image Scenes in PTW

- PTW 4.1.1 is designed to process multi-image scenes from ASARS-2, ASARS-2A, ATARS LAEO, ATARS MAEO, Global Hawk SAR, SHARP EO/IR, and SYERS EO/IR
- By agreement, all image segments are arranged according to exploitation objectives (using NITF CCS coordinates to define geometric relationships among segments)
- The collection sensor type is used to determine which characteristic image collection time pattern is appropriate
  - Scan mode SAR and optical pushbroom image segments are assembled into a single image and processed together as a single image with a single sensor model that organizes segments according to image collection time [image segments must abut]
  - For step frame scenes, the boundaries of individual segments are determined and all image support data is maintained with the associated image segments

When possible, sensor models are constructed from the aggregation of image segments

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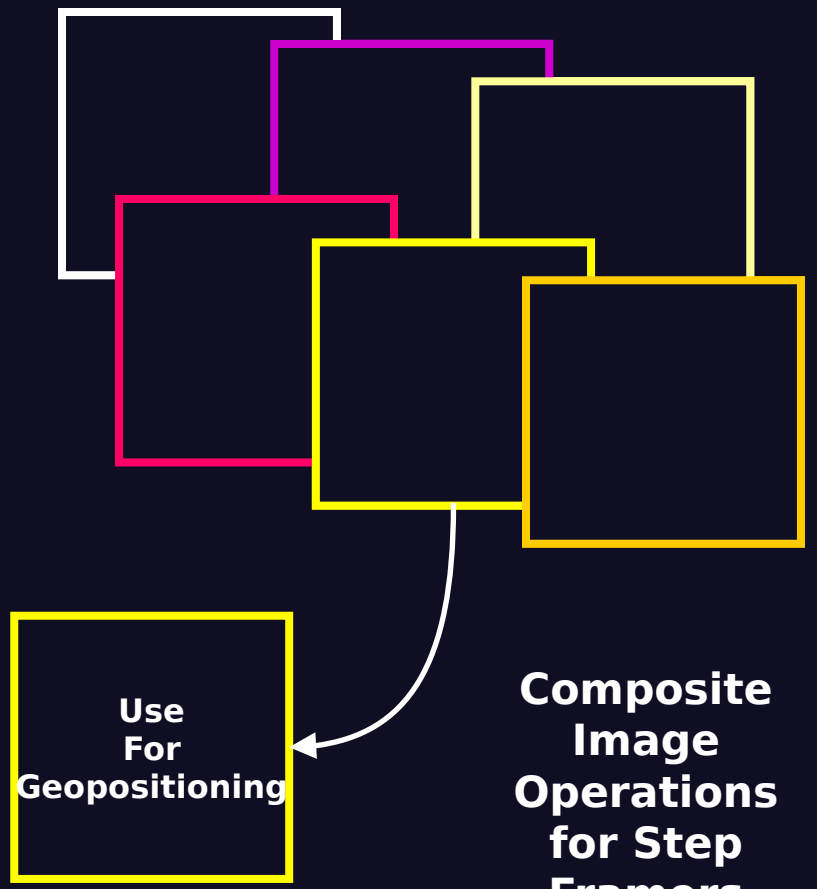
Multi-Image Scene Operations in PTW

- Create a composite image from all image segments provided within a single NITF file
- Display the composite image
  - For step framers, display the image segment boundaries
- Perform geopositioning
  - On the entire image for single-image scenes
  - On the entire composite for pushbrooms and scanners
  - On a selected image segment in all other cases (step framers)

When possible, the relationships among image segments are maintained in sensor models



Composite Image Operations for Step Framers

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Multi-Image Aggregation in PTW

	Optical Pushbroom	Scanning SAR	Chipped *
Within Segment	each image segment is a group of sequentially collected lines	each image segment is a group of sequentially processed azimuths	each image segment is a chip of a larger image
Between Segments	image segments abut and are organized time sequentially in the CCS frame	image segments abut and are organized time sequentially in the CCS frame	image segments abut and are organized according to original image position using the CCS frame
Alignment / Content	image segments align at both line ends	image segments may not align at near and far ranges	image chips may not be rectangular; some image pixels may not be valid

* Sometimes identified as mosaicked instead of chipped

CCS positions are used to communicate time and chipping relationships among image segments; normally segments abut

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A Comparison of Multi-Image Scene Sources

	Optical Whiskbroo	Optical Pushbroom	Step Framer	Video
Simultaneous collection unit	a few pixels	one line	one entire frame	one entire frame
Collection rate	very high	high	moderate	high
Between collection operations	camera orientation and platform	mainly platform motion	platform motion and camera	platform motion and camera
Platform geometry update rate	once every so often	once every so many lines	once per frame	once every so many frames
Image overlap	almost none	almost none	expected	high
Image tasking	according to a program	lines from one time to another	frames in a pattern	arbitrary

Expected overlap degrades the segment relationships using the CCS, but doesn't change the acquisition time relationships

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Future Directions

- Standards are needed for the communication of the relationships among segments of a multi-image scene
  - Image chips must be properly identifiable
  - Membership in a multi-image scene must be identifiable
  - Acquisition time information must be preserved among all elements of a multi-image scene
  - Context common to all segments must be accessible for any segment
- Accurate geopositioning is reliant upon the proper modeling of all image space, object space, and time elements of the imaging process
  - The time relationship among image segments is key
  - The implementation of multi-image constraints provides improved capability
    - adjustments to one segment affects the entire scene
    - geopositioning accuracy is statistically improved

Standards are needed to define the time relationships among the components of multi-image scenes

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